

Hit-Shaping Time Offsets and Geometry Updates

LarSoft Meeting
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H. Greenlee

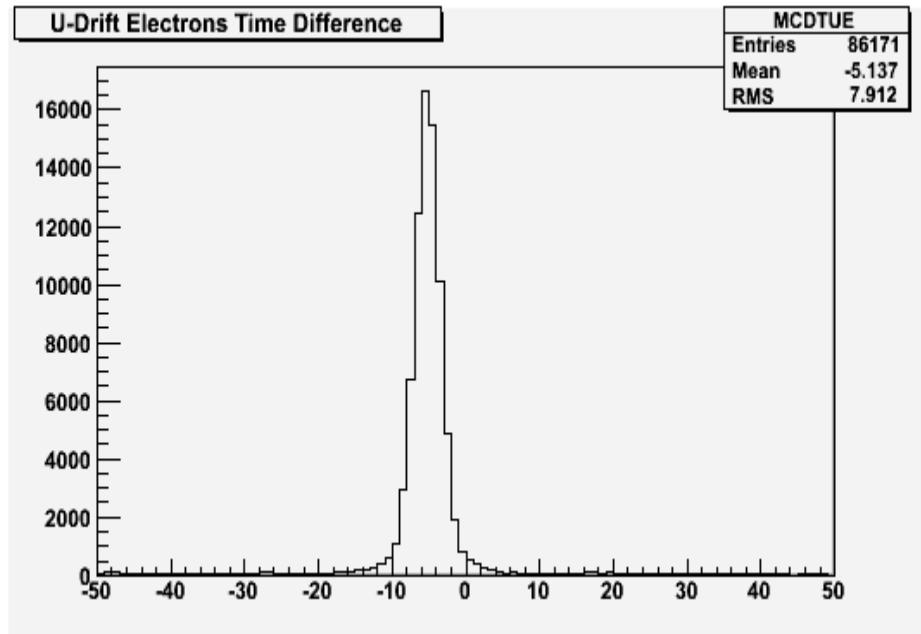
Outline

- Time offset due to convolution + deconvolution.
- Effect of recent geometry updates.

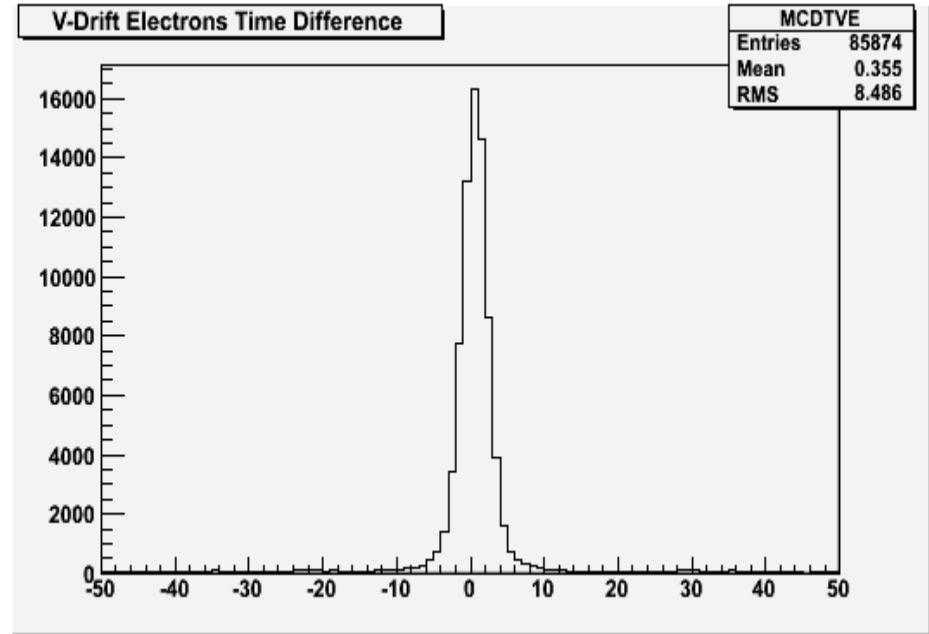
Time Offset in Simulation Due to Hit Shaping

- At the last larsoft meeting, I showed various anomalies in electron-hit time difference distribution for both simulated argoneut and microboone data (see following slides).
 - Argoneut induction plane time offset.
 - Microboone collection plane multimodal distribution.
- Latter problem was due to a simple bug in CalWire (or rather the data file read by CalWire). CalWire was using wrong response function. Fix exists, but not in svn yet.
- For this talk, I mainly want to take a closer look at the former problem (argoneut induction plane time offset), and hit-shape induced time offsets in general.

Argoneut Electrons-Hit Time Difference

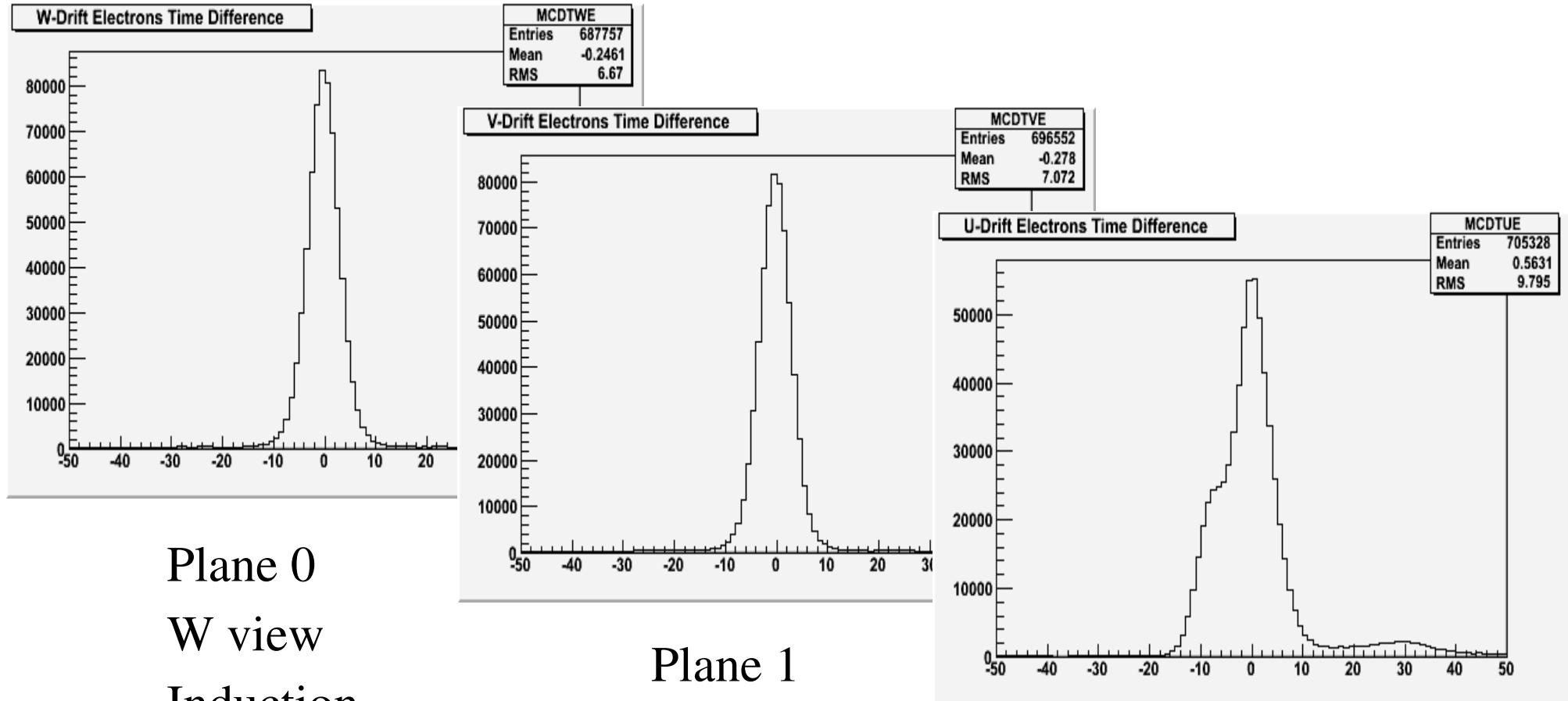


Plane 0
U view
Induction



Plane 1
V view
Collection

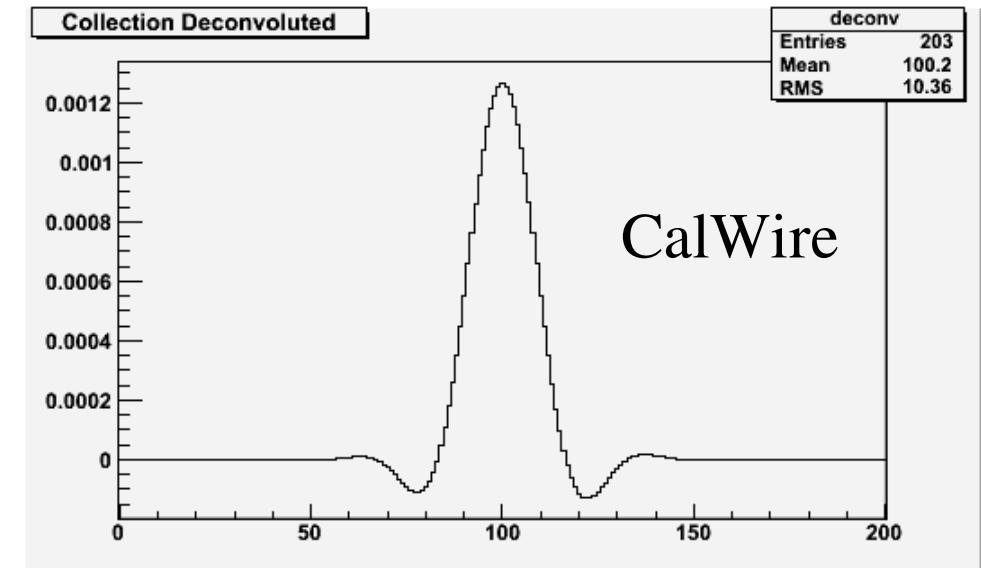
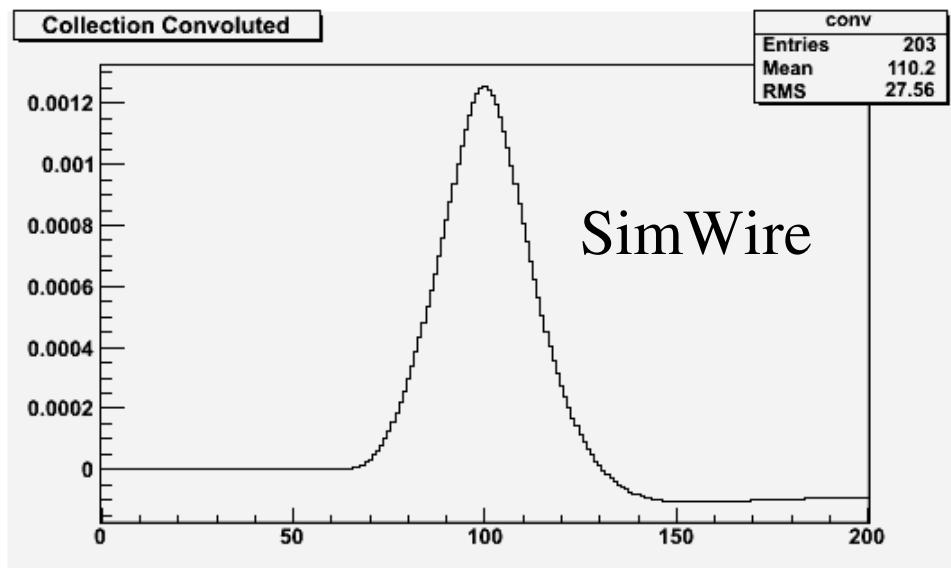
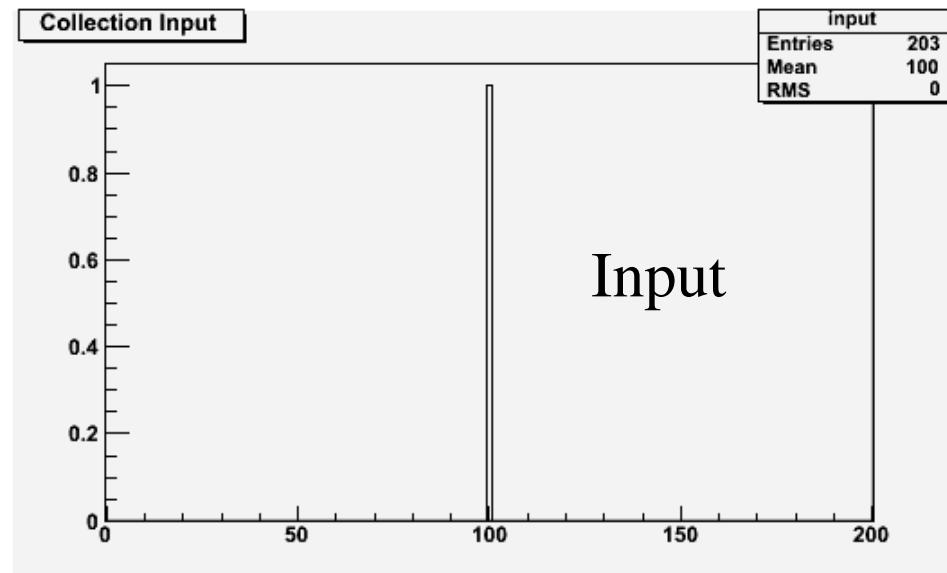
Microboone Electrons-Hit Time Difference



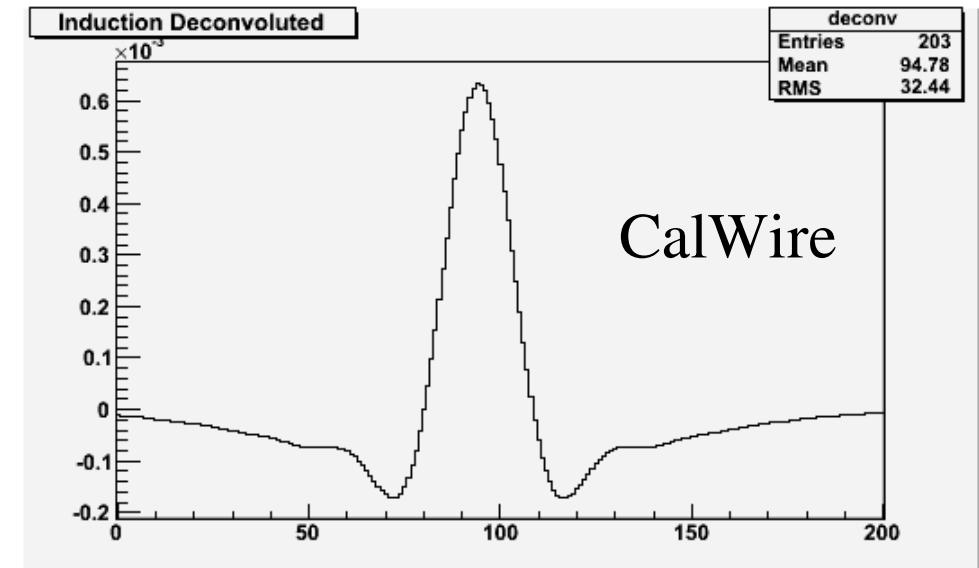
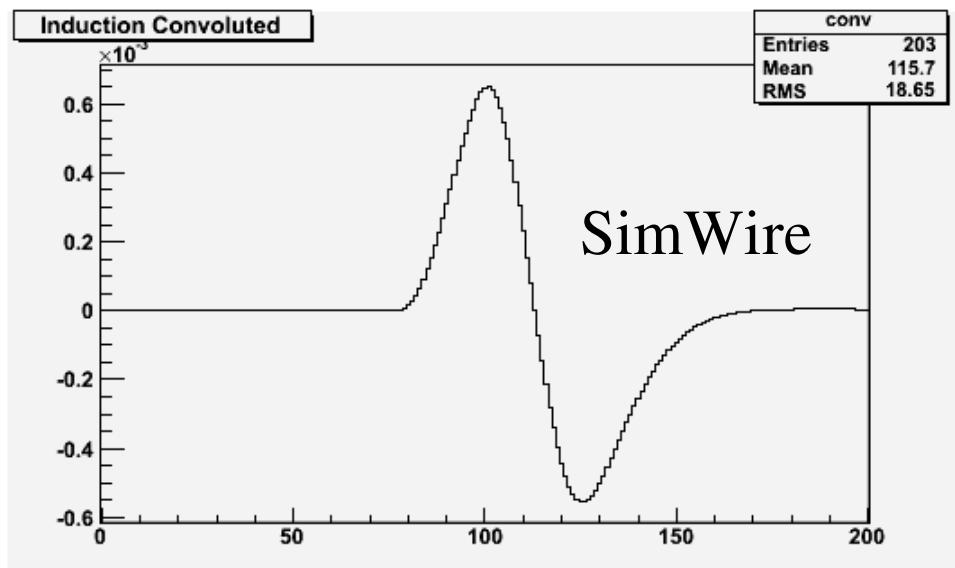
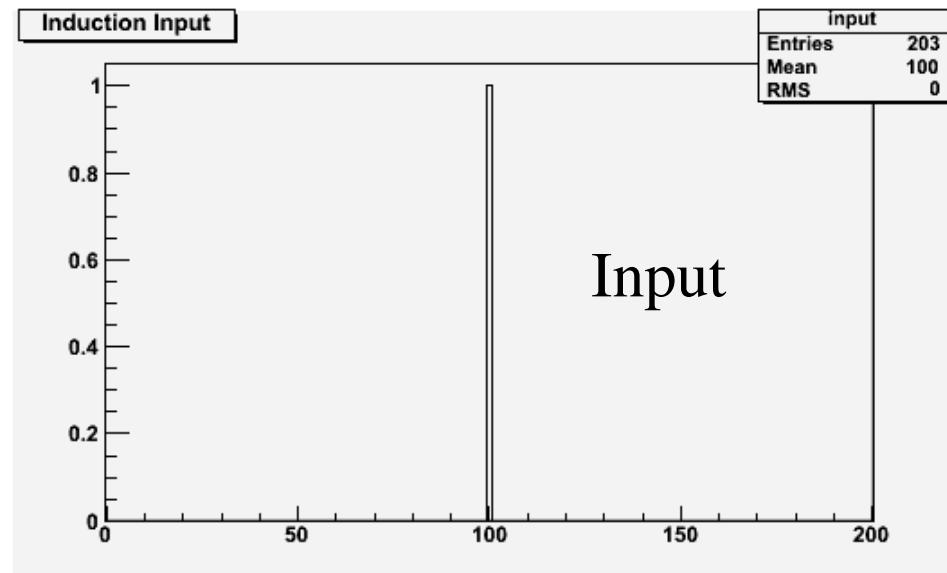
Measuring Hit-Shaping Time Offsets

- SimWire calculates the convolution kernel that it uses for hit shaping on the fly. SimWire conveniently saves the time-domain representation of the convolution kernel in a root file each time you run the simulation.
- CalWire reads frequency-domain deconvolution kernel from a permanently stored file (not in svn...).
- I wrote a small program to read both sets of kernels from their respective files and calculate the response of convolution (SimWire) + deconvolution (CalWire) to a delta function input.

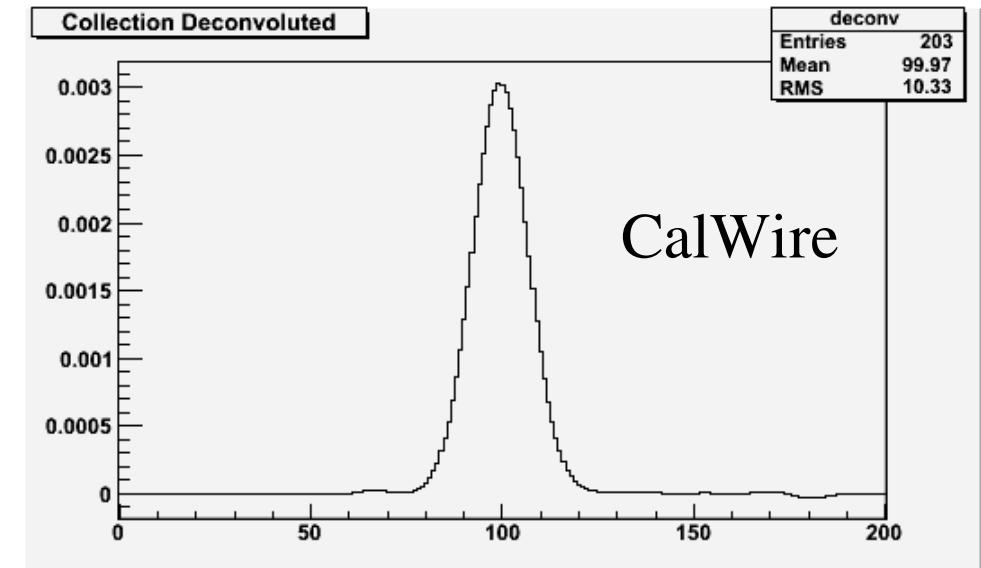
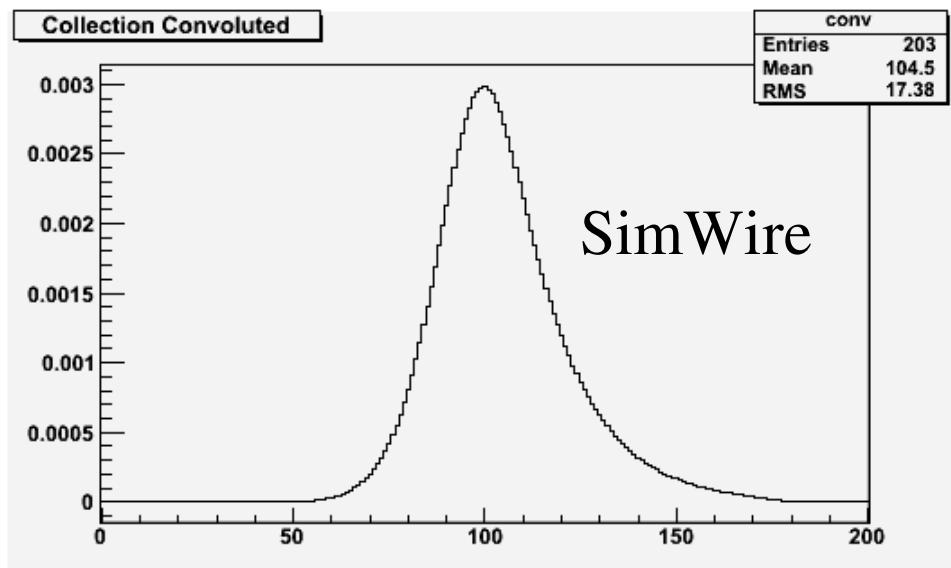
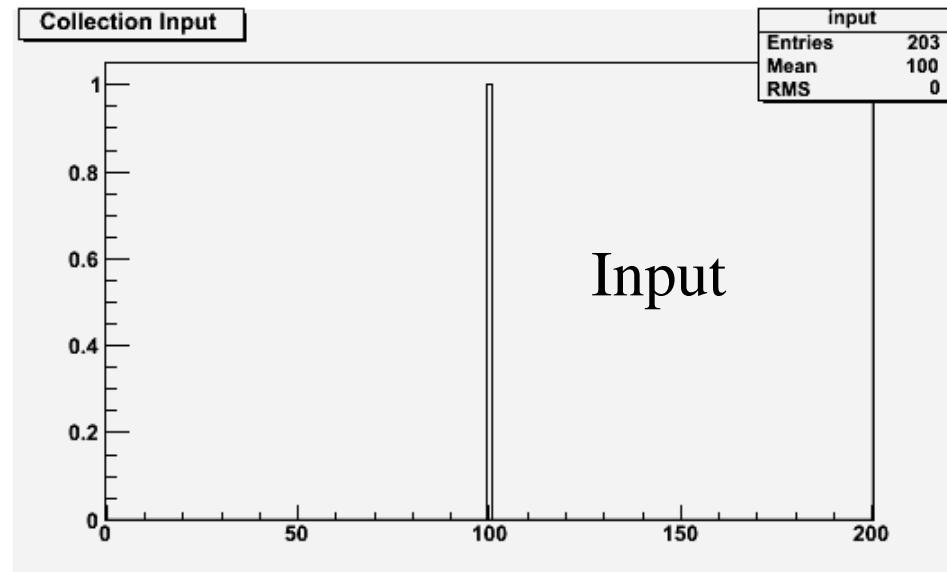
Argoneut Collection Plane



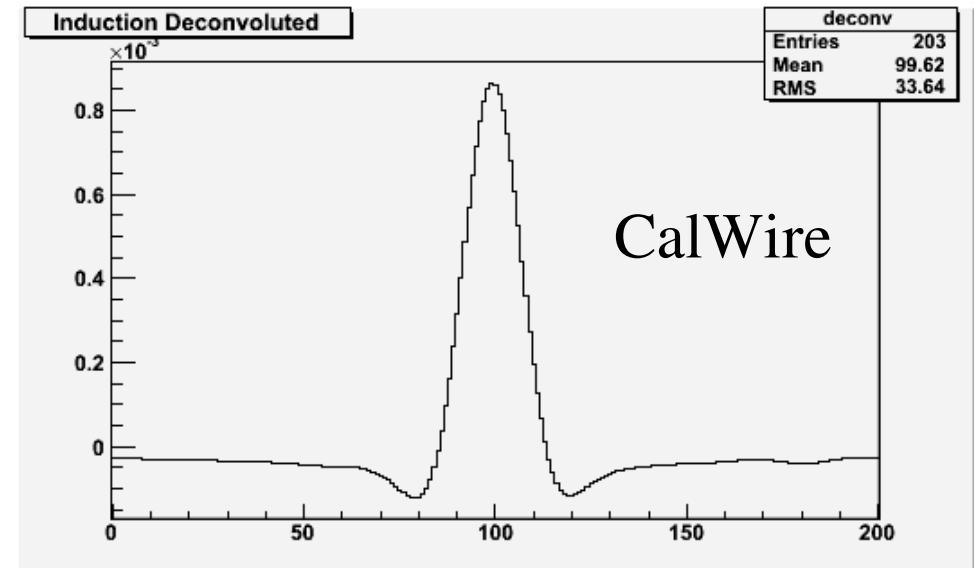
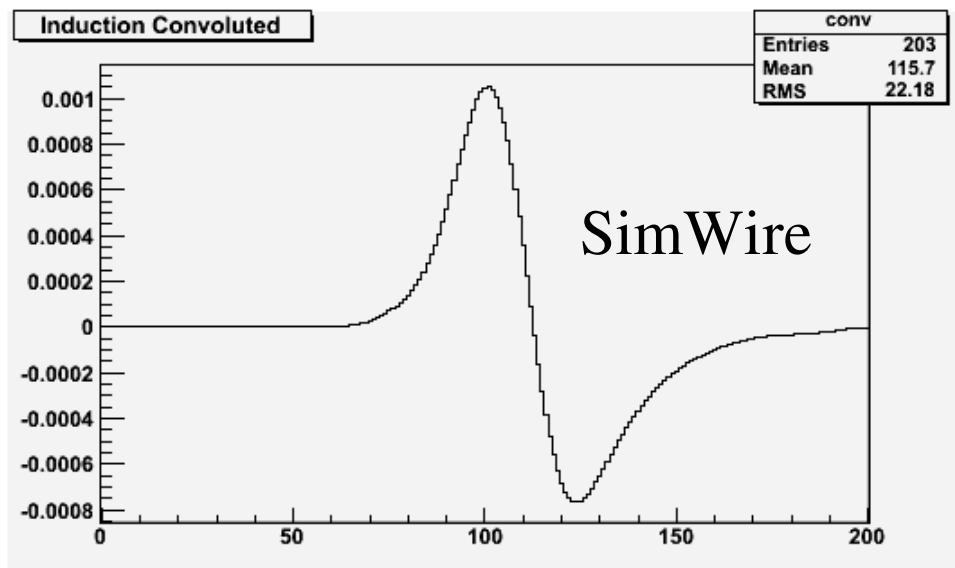
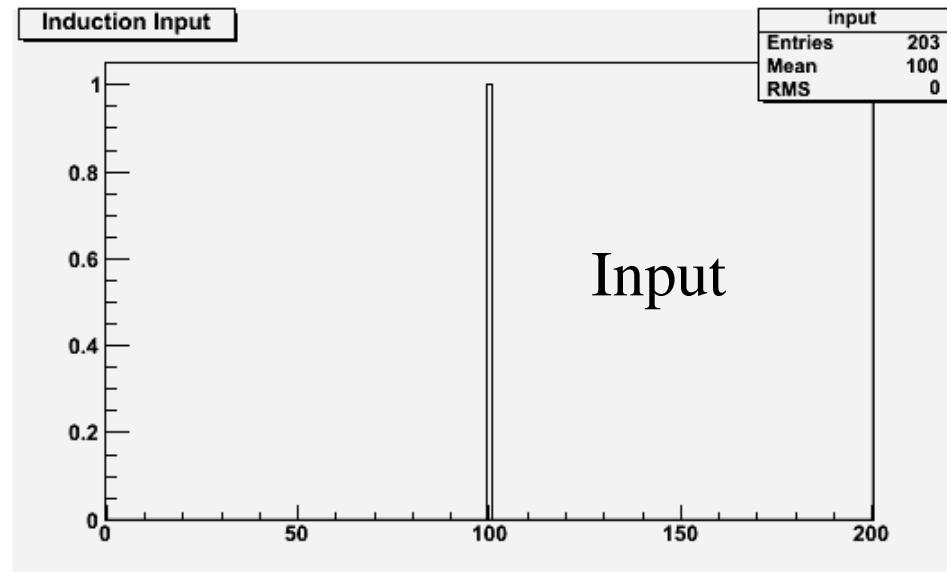
Argoneut Induction Plane



Microboone Collection Plane



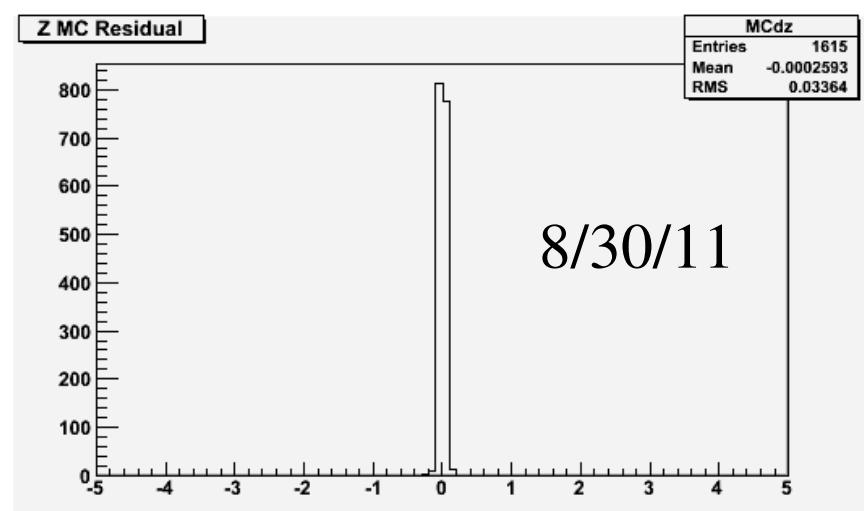
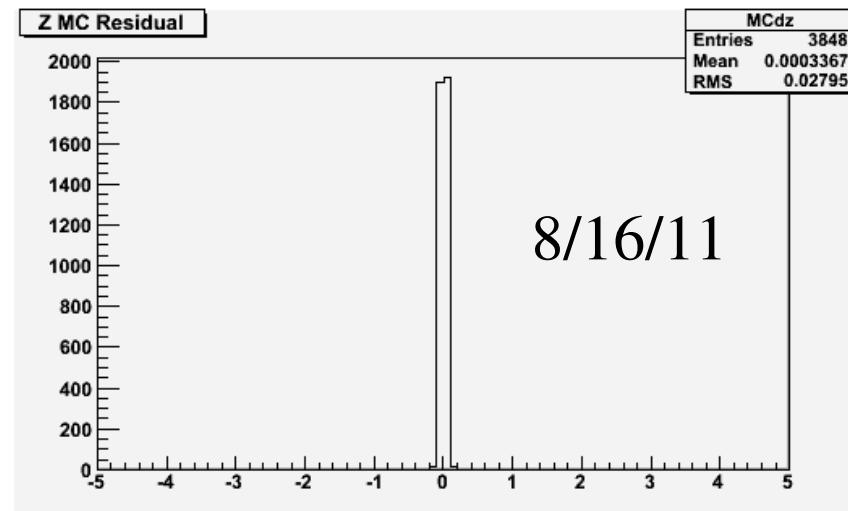
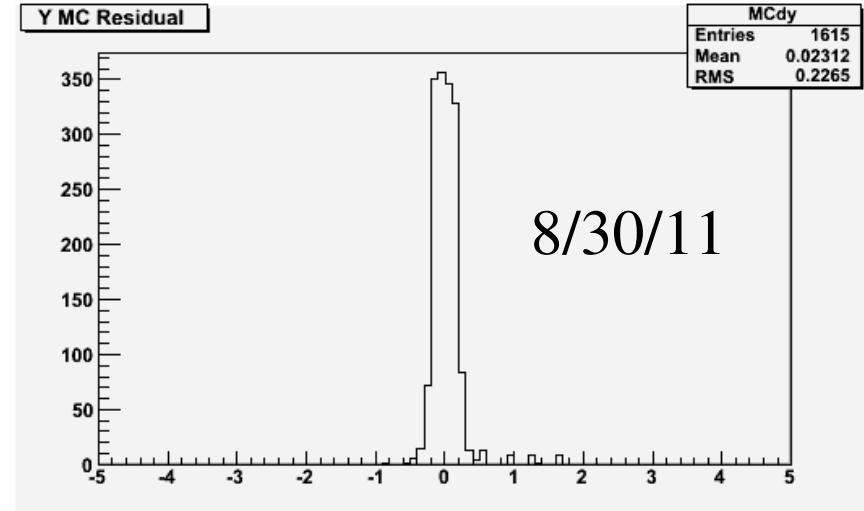
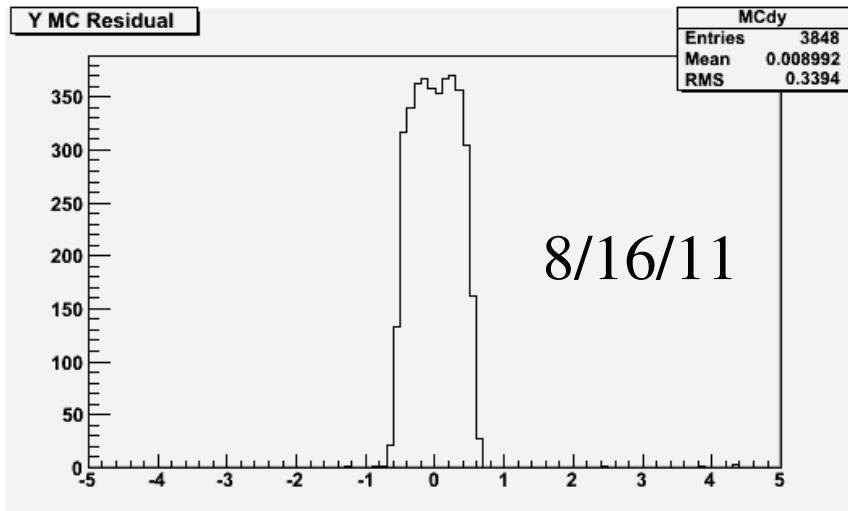
Microboone Induction Plane



Hit Shaping Conclusions

- Argoneut induction plane hit shaping introduces the -5 tick time offset as observed in electron-hit time difference plot.
Deconvoluted argoneut induction plane signal also has significant baseline undershoot (much worse than microboone induction wires).
 - Problem with argoneut induction plane hit shaping?
- Other planes (argoneut collection & both microboone signal types) do not have significant time offsets.

Effect of Recent Geometry Updates on Argoneut Space Point Position Resolution



Geometry Update (cont.)

- Argoneut y resolution has improved dramatically compared to previous geometry versions. (Argoneut y resolution was anomalously bad before update.)
- Hard to tell if z resolution has changed with current binning.
- Microboone y and z resolutions looks similar as argoneut z resolution (i.e. not anomalously bad).

Summary

- Possible problem with simulated hit-shaping for argoneut induction wires.
- CalWire still needs permanent fix for wrong response function bug.
- Response function files should be stored in svn, IMO.
- Recent geometry update has improved argoneut y resolution.
- Argoneut geometry still has non-uniform-spaced wire bug.

Backup

Absolute Readout Time in Sim + Reco

- Absolute readout time includes four contributions (plus noise).
 - $t = t_1 + t_2 + t_3 + t_4$
 - $t_1 = (x-x_0)/v$ (LArG4, drift time to plane 0).
 - $t_2 = (\text{plane-pitch})/v$ (LArG4, drift time from plane 0 to readout plane).
 - `plane-pitch = geo::TPCGeo::Plane0Pitch(plane);`
 - $t_3 = \text{trigger-offset}$ (DetSim).
 - `trigger-offset = util::DetectorProperties::TriggerOffset();`
 - $t_4 = \text{convolution} + \text{deconvolution} + \text{hit reconstruction}.$